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A closer look at small hydropower projects in India: Social acceptability of two storage-based projects in Karnataka

Johanna I. Höffken *

Eindhoven University of Technology, School of Innovation Sciences, The Netherlands

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ABSTRACT

Associated with being green, clean and small-scale, small hydroelectric power (SHP) projects generally enjoy a positive image. In India SHP promises answers to issues such as meeting a growing electricity demand, facilitating lucrative investment opportunities, and climate change considerations. The features of being green, clean and small-scale have contributed to the assumption of SHP as an essentially uncontested technology.

Empirical studies questioning this assumption are scarce. Research on SHP has so far remained rather hypothetical and policy-level-focused. This article investigates the social acceptability of small hydroelectric plants in India by empirically looking at how people engage with these plants. It thereby underlines the importance of studying technologies in their local context. Based on a detailed case study analysis of two SHP projects in Karnataka, India, the article shows how SHP projects are contested on the local level. The engagement of local people played a crucial role in the contestation of the plants and led to significant and unexpected outcomes and effects.

The article highlights the importance of having a broader perspective in the development of SHP that goes beyond a mindset of technological fixes. This includes taking account of existing water infrastructure and a broader range of water users. The article shows that the implementation of SHP projects does not take place in a void. Rather, complex existing physical and social realities on the ground matter for the development and performance of SHP.

Contents

* Tel.: +31 40 247 3408; fax: +31 40 244 4602.
E-mail address: j.i.hoffken@tue.nl

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1. Introduction

Associated with being green, clean and small-scale, small hydroelectric power (SHP) projects harbor promises. In India, these promises are mainly related to providing answers to three broad issues, namely the country's growing electricity demand, the facilitation of lucrative investment opportunities, and climate change considerations.

India's electricity demand is growing rapidly, while its electricity system is struggling with severe performance deficits comprising organization, access and supply alike [1]. Renewable energy technologies play a role especially with regard to the last one. In order to diversify the country's power generation mix, the Government of India (GOI) has issued several national policies to promote their further development [2,3]. As part of the renewable energy mix small hydropower accounts for about 13% of India's total grid-connected renewable power generation [4]. It thereby constitutes the second largest grid-connected renewable energy source after wind power.

While the mandate over large hydro projects rests with India's Ministry of Power, SHP with a capacity up to 25 MW are administered by the Ministry of New and Renewable Energy Sources (MNRE). MNRE considers small hydro projects as “one of the most attractive renewable source of grid quality power generation” [5]. It supports the promotion and development of small hydropower by encouraging plans of capacity addition and providing capital subsidies and preferential tariffs [3]. Facilitating conditions for private sector participation has helped to promote SHP as attractive business opportunities and interesting investment objects [6].

All this has contributed to the overall image of small hydropower as a technology that promises green (renewable) and clean (no CO_2 emissions) electricity on a small scale, often provided by private actors. This image fosters the assumption that – due to their features – SHP is an essentially uncontested technology. Contrary to large hydro projects, which in India have a long history of social contestation [7–13], SHP are not associated with large-scale submergence and its related environmental and societal implications. Thus, consequences of changing the water flow, issues of crop loss, resettlement and compensation claims, are acknowledged problems that are expected in the context of large hydro development – and not in connection to SHP [14–16]. This has led some to see SHP as an alternative to large hydro projects [17–19]. Accordingly, rather than societal challenges, impediments of the further development of SHP are seen much more in the lack of financing, and in regulatory and infrastructural issues [20,21].

This assumption about SHP as a socially uncontested technology also seems to underpin the scholarly debate. There is a large body of literature, which, in the case of India, has comprised a bandwidth of issues.

One theme in the debate has highlighted the potential that renewable energy sources provide for sustainable development in India [22]. Nautiyal et al. have detailed this for the specific case of small hydropower, arguing for the need to continue the establishment of new SHP projects [23]. A recurring argument in this context is the assumed potential of SHP projects in mitigating CO_2 emissions [24,25]. Abbasi and Abbasi provide one of the few critiques that have highlighted their potential adverse environmental impacts [26].

The analysis of existing policies and mechanisms forms another strand of research within the debate. Sharma et al. have recently provided an analysis of different existing national policies and strategies and stress the large untapped potential and overall importance of SHP projects in India's overall development [3]. Singh et al. have studied the mechanisms of renewable energy policies by concentrating on investment and fiscal related aspects [27]. This research direction is complemented by studies investigating questions of financing and cost optimization of small hydro projects [28,29]. A recent contribution of Laghari et al. exploring technical alternatives and new designs of small hydropower equipment points to yet another branch within the debate that concentrates on technical design issues [30].

The facilitation of SHP constitutes the general thrust of the ongoing debate. Accordingly, SHP research in India has concentrated on policy, financial, and technical conditions and contexts. The current research scope shows that SHP is not considered a worthwhile topic of study in the context of social contestation and acceptance. A consequence is the striking absence of empirical studies investigating how these plants are actually doing in practice.

Especially research in the field of Science and Technology Studies (STS) has contributed to the insight that the functioning of technologies in society not only depends on the technologies' technical performance, but is also linked to their societal embeddedness [31,32]. The question about the social acceptability of technologies in society ultimately corresponds to the democratic claim that people should have a say in the development of science and technology in society. Besides reasons of normativity, instrumental arguments, for example issued within the field of development studies, stress that people's engagement will raise the effectiveness and efficiency of development efforts by rendering them a voice and active role in the process [33].

This article investigates the social acceptability of small hydroelectric plants in India by empirically looking at how people engage with these plants. It thereby underlines the importance of studying technologies in their local context. It is only through these studies that we can learn about the social acceptability of technologies. Taking a closer look at SHP through the lens of engagement adds empirically grounded insights to the debate about SHP, which so far has remained rather hypothetical and policy level-focused. As will be shown, people's engagement may lead to unexpected design changes, and thus plays a significant role in the functioning of SHP projects.

2. Methods

Though SHP is developed all over India [34], research about the social acceptability of SHP plants in India is scarce. The material presented in this article aims to start filling this gap. It is framed within a qualitative research design. Qualitative research seeks to provide a rich, contextualized understanding of lived social experience through the intensive study of particular cases. Ethnographic field research was conducted in India at the site of two

SHP projects, which will be detailed below. In ethnographic research approaches people are studied within their natural settings to document how they behave and attach meanings to the realities they live in. In contrast to quantitative research, qualitative ethnographic research is not marked by separate research stages but characterized by an iterative process of data gathering and analysis [35].

Ethnographic field research in India took place during several extended periods in 2010 and 2011. A range of empirical materials was gathered, including documentation about or related to the cases under study, such as detailed project reports, minutes of meetings, letters, and newspaper clippings.[1] The main empirical source of this analysis, however, consists of over 40 interviews, which were conducted using a semi-structured interview format. Semi-structured interviews are loosely structured in-depth interviews, in which the interviewer aims to learn about the worldview of the interview subject, rather than aiming to elicit preconceived information. This interview format proved to be particularly useful in order to learn about the social acceptability of SHP in India. The semi-structured interview format provided rich empirical data about two main question clusters revolving around issues in connection with the local development of SHP and people's engagement with the plants. In-depth interviews were held with a broad range of actors, including farmers, politicians, civil servants, SHP developers, business people, development practitioners, and academics.[2] These accounts have been transcribed, coded and – in combination with other empirical data – analyzed in view of the overall research interest in the social acceptability of SHP in India.

The most common approaches of analyzing qualitative ethnographic material have been grounded theory approaches [36]. Originally developed by Glaser and Strauss [37], grounded theory has now become "an umbrella covering several different variants, emphases, and directions – and ways to think about data" [38]. One core result that grounded theory approaches seek to accomplish is to induce theory from empirical material through the ongoing interpretation of that data. The analysis of the material presented in this article is informed by grounded theory, especially its emphasis on an inductive approach of data gathering and analysis. This approach proved to be especially suitable considering the scant availability of qualitative research data about the social acceptability of SHP in India.

The results of the analysis of the interviews and other empirical material are an account of case studies that are rendered in "thick description"[39], for example by including interview accounts verbatim and other rich descriptive information related to the case contexts. Thick descriptions form part of the qualitative research strategies to enable the generalizability of the findings, since they allow a so-called case-to-case translation by enabling the reader to make inferences about extrapolating the findings to other settings [40]. This article is written in this light.

3. A closer look: SHP projects along the Tungabhadra river

3.1. Policy and case study contexts

To learn about the social acceptability of SHP, research focused on the engagement of people at the site of two privately owned plants in Karnataka. Of the 939 SHP plants in India with an installed capacity of 3496.145 MW, 132 projects are located in the South Indian state of Karnataka. This makes Karnataka one of the states with the highest number of existing plants and the highest amount of installed capacity (915.395 MW). As of 2012 a total of 327 plants were under construction in India, of which 41 projects are in Karnataka. Thereby Karnataka also ranges among those states with the highest number of plants that are being implemented [5]. The government of Karnataka aims to generate 20% of the overall electricity through renewable based energy projects. It promotes and details its efforts in the field of renewable energy with its renewable energy policy aiming "to harness green, clean renewable energy sources for environmental benefits and energy security" [41]. The private sector is ascribed an important role in this.

The possibility for private enterprises to play a role in India's electricity sector is the result of developments which started in the 1990s. Macroeconomic reforms were aimed at market liberalization in diverse sectors formerly owned and controlled by the government. For the electricity sector the reforms paved the way for the entry of private electricity generating companies.

The Electricity Act of 2003, including its amendments in 2007, represents the most recent effort by the Indian Government to govern the electricity sector. It replaces all existing legislation and thereby establishes an all-encompassing legal framework. The Act can be seen as integrating and continuing earlier approaches of economic liberalization. "Introducing competition in every link of the power supply chain", the main focus of the Act is seen to concentrate on increasing the commercial viability of the electricity sector [42]. However, the Act also stimulated a renewed impetus on rural electrification [43,44] and the consideration of renewable energy options. The Act is seen as marking an important legislative development towards the promotion of renewable energy sources, as it recognizes the role of renewable energy technologies for supplying power to the utility grid. The stipulation that renewable energy must constitute part of the electricity purchases of the distribution companies surely enforces this [45]. The National Electricity Policy 2005, the National Tariff Policy 2006, and the National Rural Electrification Policies 2006 are regarded as important follow-up legislation, that detail the overall line set out by the Electricity Act [2,23].

This policy context, marked by efforts towards economic liberalization, embeds the two small hydroelectric projects that will be the focus of the following section. The two grid-connected projects contribute to Karnataka's endeavors to increase the share of renewable based energy in the state's overall electricity mix through private sector participation. More generally, the projects can be seen as a manifestation of India's endeavors to find answers to the pressing issues of rising electricity demand, economic development and climate change.

It is the water of the Tungabhadra river that the two SHP projects use for power generation. The Tungabhadra river is one of the major rivers in South India, flowing through the states of Karnataka and Andhra Pradesh. Since its completion in 1953 Tungabhadra's waters are controlled by the Tungabhadra dam. The dam is built close to Hospet, the regional municipal center of Bellary District in Karnataka, damming the river on its onward journey eastwards. The Tungabhadra dam is designed as a multipurpose dam. Apart from its function to produce electricity, it also serves for irrigation purposes and flood control.

With the arrival of the heavy South-Western monsoon around June and July, India's rivers start to swell. Dams are often described as "harvesting" water. Especially in view of the heavy monsoon rainfalls, this metaphor describes vividly how the water of a dam's catchment area is "collected" and starts filling up the reservoir. The moment at which the gates are or have to be opened depends on the influx of the water and the dam's and reservoir's design and

[1] A list of references to specific documentation regarding the case studies has been included in Appendix A.

[2] An overview of interviewees has been included in Appendix B. To protect anonymity all interviewees' names and the names of the companies have been changed/and or anonymized.

overall condition.[3] If possible, authorities try to parallel the opening of the dam's gates with a prestigious date. At the Tungabhadra dam this date is set on August 15, the day commemorating India's Independence in 1947. These yearly induced floods influence the rhythms of the water flow and thereby the life along the river. Being built 50 and 70 km downstream of the Tungabhadra dam the two SHP projects, too, are exposed to these dynamics.

Tungabhadra's waters had been managed by water infrastructures long before the Tungabhadra dam was built. Ruling over wide parts of medieval South India, the rulers of the Vijayanagara empire (mid-1400 until mid-1700) left infrastructural marks along the rivers. Under their rule, many so-called “anicuts” were constructed, curiously shaped low water barriers. In pre-colonial times there used to many of these curved diversion structures crossing the riverbed [46]. The purpose of an anicut was to slightly raise the water level thereby slowing down the river flow. Often, anicuts enabled the diversion of some of the water to a canal positioned just before the anicut. While dams are barriers blocking the water flow and creating a reservoir behind the dam, anicuts leave most of the river's water flowing to allow a majority of the water to spill over the structure and move downstream.

These complex existing water infrastructures and dynamics describe the context of the two hydro projects, which both made use of anicuts in the construction designs of their plants. As will become clear these contextual factors are crucial for understanding the events unfolding at the two projects, and thereby for learning about the social acceptability of the plants.

3.2. The Navya plant near Kenchanaguddam village

In 2005 the 6 MW plant of the Hyderabad-based company Navya Ltd. took up hydroelectric power generation along the Tungabhadra river. The construction of Navya's plant close to the Kenchanaguddam village included the use of a series of existing anicuts that are located upstream of the plant. The company incorporated the anicuts in their plant-layout to increase the diversion of Tungabhadra's water towards their powerhouse.

3.2.1. The plant's layout

In the upstream region of the plant, Tungabhadra's riverbed becomes veined, splitting into diverse arms. One of these arm splits into three smaller arms at a distance of about 2 km away from the powerhouse. It is here that a series of seven successive anicuts starts. The so-called Gangammana anicut near the powerhouse is the last of the series of anicuts that are built along the right arm (see Fig. 1).

By strengthening the existing old anicuts, which, according to the project's report, were “dilapidated and leaking profusely” [47], the water flow changed. As a consequence of the strengthened anicuts, the left and middle arms receive less water, because the newly fortified anicuts now divert most of the water towards the right arm. To profit from this increased water supply flowing through the right arm, the powerhouse is located at its end.

The incorporation of the anicuts into the plant's design is of significance because it changed the existing dynamics of water flows. Close to the power plant two irrigation canals take off. The Deshnur canal departs downstream of the powerhouse. The Sirguppa canal departs right next to the inlet of the power plant's intake canal. In an Irrigation Department document the Deshnur canal and the Sirguppa canal are referred to as the “Vijayanagara Channels” that are part of the “Medieval irrigation systems of the Tungabhadra River” [48]. Not without pride is it mentioned that “work [on these Vijayanagar canals] was taken up during 1509–1530 A.D. in the regime of reputed king of Vijayanagara Sri Krishnadevaraya” [48]. Both irrigation canals are still in use today. As a consequence of the fortified anicut series, the Deshnur canal receives less water because it is mainly fed by the river's middle arm. The fortification of the anicut series hinders the water from running down the middle arm towards the Deshnur canal. The water supply of the Sirguppa canal, however, is increased because the strengthened anicuts divert more water towards the right arm, along which the Sirguppa canal and the power plant are located (see Fig. 2).

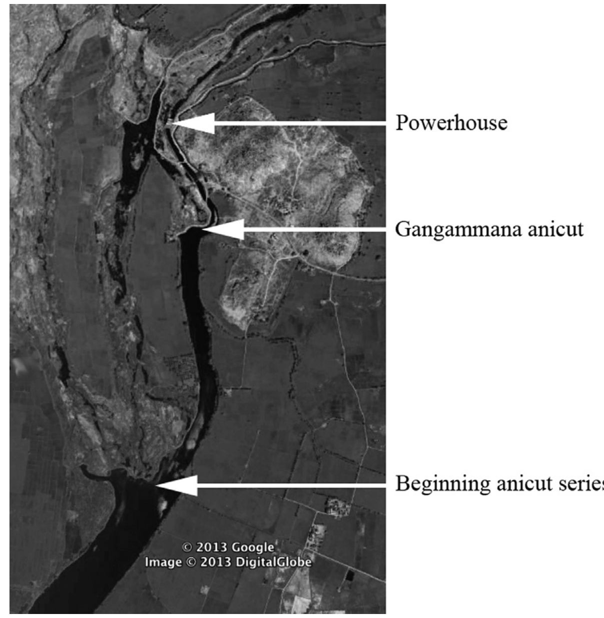


Fig. 1. Bird's-eye view of Tungabhadra's three arms and built infrastructure. (All bird's-eye pictures are adapted from Google Earth.)

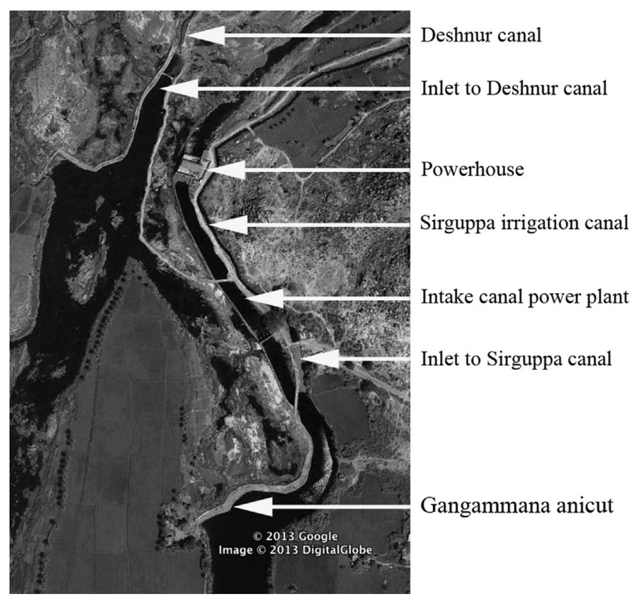


Fig. 2. Bird's-eye view displaying Tungabhadra's (dark) waters as well as built infrastructure at the Kenchanaguddam plant site.

[3] Tungabhadra dam's reservoir was designed to have a capacity of 133 tmcft (TMC) [83]. Tmcft or TMC is the abbreviation for a volumetric unit and stands for “one thousand million cubic feet”. Due to heavy silt formation by 2012 the capacity is estimated to be significantly less, i.e., around 105 tmcft [84].

3.2.2. Water impacts

Changing the flow of water not only increased the availability of water for power generation at the plant, but also had a direct impact on the livelihoods of farming households in the area. For Kenchanaguddam village, located about 2 km off Tungabhadra's right arm, the plant's construction entailed increased water availability. Kenchanaguddam has 955 households; over 80% of the working population works in the agricultural sector [49]. In a drought prone state such as Karnataka, in which two-third of its geographical area has arid and semi-arid conditions [50], increased availability of water constitutes a significant advantage for farmers. Not surprisingly, when asked about the situation after the construction of the plant members of Kenchanaguddam's village government or Gram Panchayat (GP) stressed, "the plant is helping us because more water is stored, which we use for cultivation of land" [51]. Especially the strengthened Gangammana anicut, the last anicut of the diversion series in combination with the fairly long intake canal leading the water towards the power house, slows down Tungabhadra's water flow and has a water storage effect. The water slowing and storing feature makes the water easier accessible and longer available for cultivation and drinking purposes.

The reaction of the small group of farmers, whose lands are served by the Deshnur canal, was quite different. Alerted by the deprivation of water due to the construction of the plant they started to question the plant's design. Farmer Vedant, their spokesperson, emphasized, "Hundreds of years back, our ancient people built these anicuts by using not a single bag of cement! But these people [Navya] have spoilt the anicuts by using cement" [52]. The Deshnur canal used to be fed by water overflowing and leaking through the Arelli anicut as well as the Gangammana anicut. The Arelli anicut is the first of the anicut series and is built across the middle arm, diverting the water towards the right arm. The Gangammana anicut is the last of the anicuts and diverts the water into the Sirguppa canal and Navya's intake canal. Before the establishment of the Navya plant, water used to flow down Tungabhadra's middle as well as right arm and reached the Deshnur canal. Yet by implementing the "plugging of leakages at the existing 7 anicuts" [53] as foreseen in the project report of the Navya plant, the water flow changed, depriving the Deshnur canal of water during times of low water tables.

3.2.3. Anicuts

Between March and June, the hot and dry summer period, Tungabhadra's water tables are low and water is scarce. The anicuts strengthened with cemented "random rubble masonry" [53] hinder the little water, which flows in the river during this period to trickle through the anicuts. Water cannot overflow the anicut because of the very low water tables, nor can it leak through the anicuts because they were turned into solid barriers. Consequently, the anicuts located at the upper part divert the available water away from the middle arm towards the right arm where the Gangammana anicut diverts the water finally into the plant's intake canal and the Sirguppa irrigation canal. During July and September, however, when the monsoon-rain-waters and dam releases fill Tungabhadra's waterbed, the water tables are so high that they overflow the anicuts reaching the Deshnur canal. The availability of water for the farmers served by the Deshnur canal is thus only an issue during the periods of the hot and dry summer months.

Vedant's statements about the permeability of the anicuts implied that a characteristic design feature of the anicut series consisted of their leakage ensuring a small water flow even during low water tables. Detailed research on anicuts is scant and Krishnan's exceptional study of these structures in South India is "a first step in conducting an engineering analysis of traditional irrigation systems" [54]. In her research she focuses on the anicuts' diverse shapes and their relation to bed sediment transport effects but does not elaborate on the masonry of the anicuts. Agarwal and Narain mention in their overview and compilation of India's traditional harvesting structures that "anicuts on the Tungabhadra River … were all constructed by the Vijayanagar kings [and] all of them are made of large boulders and rough masses of stone piled upon the other without mortar or cement" [55]. Yet, neither Krishnan nor Agarwal and Narain are concerned with leakage as an intended feature of anicuts. Local sources in the form of interview accounts and government and survey documentation about the anicut series describe their packed, yet permeable boulder-structure. Furthermore, the placement and layout of the anicut series speaks for a design that allowed some water to leak through the anicuts. Despite their common underlying engineering principles the design of traditional anicuts was varied and adapted to local circumstances. This points to both the lack and the importance of empirical research into design features of traditional anicuts that in pre-colonial times used to be common and numerous, especially in South India [56,46].

3.2.4. Protests and design changes

Faced with water deprivation, Vedant initiated protests in the name of those affected by the water scarcity of the Deshnur canal by paying numerous visits to the Irrigation Department, which is responsible to ensure and monitor the distribution of irrigation water in the region. Besides these direct interactions with officials his engagement also comprised letter correspondence in which he stated his concerns regarding the impact of the plant's design for the Deshnur canal. To avoid water deprivation he proposed to install extra sluice gates to facilitate the water flow towards the Deshnur canal. The power plant's detailed project report did not foresee extra sluice gates. While the strengthening of the anicut series formed an integral part of the plant's report, any changes to the water supply resulting from this intervention that did not affect the plant itself were not considered. Only due to Vedant's engagement the issue of extra sluice gates for the Deshnur canal became an action point on the agendas of the Irrigation Department and Navya's management. Finally, two gates were installed in the intake canal's sidewall.

According to Vedant, the pressure of an influential farmers' lobby from Kenchanaguddam played a decisive role in the placing of the sluice gates. Vedant had initially proposed to the Irrigation Department to install gates in the Gangammana anicut, but "these Kenchanaguddam people, these canal people objected it" [52]. For people profiting from the Sirguppa canal, installing gates in the Gangammana anicut only meant that less water would reach "their" Sirguppa canal, because part of the water, which the Gangammana anicut diverted towards the plant and irrigation canal inlet, would be discharged through the sluice gates.

From the Irrigation Department's and the company's point of view the other reasons speaking against the Gangammana gates were their substantial destruction of a part of this archeological monument, as well as higher installation costs compared to the canal wall option. Whichever reason may have prevailed, the Department's decision was to install two sluice gates in the wall of the intake canal. Water is thus first led towards the irrigation and the intake canal. Only from there can it be released through the wall into the riverbed where the Deshnur anicut's right leg diverts the water towards the inlet of the Deshnur canal (see Fig. 3).

3.2.5. Ongoing contestation

With the installation of the two gates, the controversy about the water flow did not end. The conflict shifted to the opening of

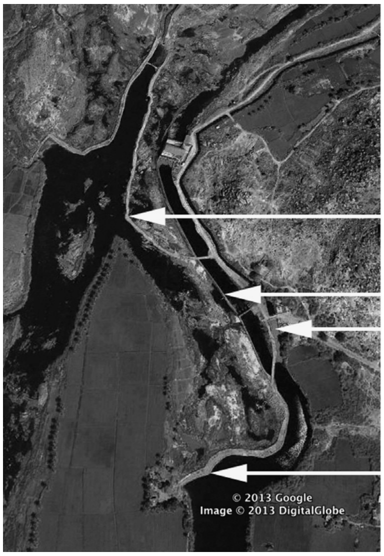


Fig. 3. Bird's-eye view of the built infrastructure at the plant.

the gates. The influential leaders of Kenchanaguddam's farmers' lobby and their ability to mobilize a mass of followers play a crucial role in this. When the gates are to be operated a mass of farmers is convoked by the farmers' lobby to raucously protest against the opening.

Studies investigating Indian social power structures have found a rising influence of peasants after India's Independence [57,58]. The phenomenon of the rising power of peasants augmented explanations of social power structures in rural areas based on the "dominant caste theory". This theory finds that there exists a dominant caste in many villages, which has access to most of the local power resources. Although the dominant caste theory is not neglected, it is now an accepted finding that there has been a decline of power of the traditional elite castes in India [58]. With the ascendancy of peasants and the decline of caste hierarchies, the notion of "faction" emerged to account for processes of conflict at the rural level [59,60]. And though there are different definitions of the term, "factions usually refer to informal, spontaneous, leader-follower groups organized for a particular purpose which disband when that purpose has been accomplished" [61]. The informal structure and the temporary amassing of many people at the plant with the purpose of protesting against the gates' opening underline the factional character of the Kenchanaguddam lobby.

The objection by the lobby and their mobilized followers to the opening of the gates is, however, surprising. The sluice gates are located in the wall of the plant's intake canal, downstream of the inlet to the Sirguppa canal. Consequently, for people served by the Sirguppa canal the opening of the sluice gates to the Deshnur canal does not impact on their availability of water. For the plant management, on the other hand, the discharge of water through the sluice gates diminishes the amount of water flowing towards the turbines of their powerhouse. This led Vedant to accuse the Navya plant management of "instrumentalizing" leaders of Kenchanaguddam by paying them to instigate protests every time the sluice gates to the Deshnur canal are to be opened.

3.2.6. *Current situation*

Despite these accusations, Vedant and others served by the Deshnur canal, however, did not follow up on this matter. Two main reasons may explain why they gave up trying to ensure the water flow to the Deshnur canal. The canal is small, serving only a few hundred acres; so, the number of affected farmers is low compared to those located on the other side of the river who benefit from the plant. The small number of affected farmers cannot keep up with the strong and numerous farmers' lobby from Kenchanaguddam. But apart from resigning due to lack of support, the availability of pump sets installed downstream of the powerhouse in the right and left arms of the river explains why the engagement by the Deshnur canal people stopped. Due to the pump sets, Vedant and others are not dependent on the water flow of the Deshnur canal, as the sets pump the water from the Tungabhadra river towards the fields.

For Vedant and others served by the Deshnur canal, the establishment of the Navya power plant in 2005 aggravated the water scarcity faced during the dry summer months. The installation of sluice gates did not alleviate the situation. The conflict over the opening of the sluice gates is a repeating event. Every year when the Deshnur canal dries out and the local Irrigation Department is contacted to open the sluice gates, people from Kenchanaguddam start massive protests. "Some people are having an advantage, some people are having a disadvantage" [52]. This statement by Vedant seems to provide an adequate description of the situation after the construction of Navya's power plant along the Tungabhadra river.

3.3. *The Bhavya plant near Sugur village*

About 20 km upstream of Navya's SHP project, Tungabhadra's waters are also used for power generation. The construction of this small hydroelectric plant included the incorporation of an anicut that stretches in a crescent shape from one riverbank to the other. The passing of time and the flow of water had left their marks on the Vijayanagar anicut. The villages of Sugur and Mannur on the right bank of the river and Bennur and Ullenoor on its left bank are the main villages served by this old anicut. Sugur and Mannur count 970, Bennur 449 and Ullenoor 606 households. Similar to the case in Kenchanaguddam over 80% of the working population is dependent on the agricultural sector [49]. Originally, the anicut was designed to function as a check dam by slowing down the velocity of the water. Though deteriorating, the anicut still had a slowing down effect on Tungabhadra's water flow, such that it facilitated the fetching of drinking water and the installation of irrigation pump sets that pump the water to the fields inland.

3.3.1. *Heightening the anicut*

It is this location that the ABC Power Industries deemed as an advantageous site for building a 4.5 MW hydroelectric plant with its powerhouse on the right bank close to the village of Sugur. For the company, incorporating the crescent shaped anicut in the plant's design was of interest, as it could be used to divert water towards the powerhouse and its turbines. With the construction work starting in late 2002, the company strengthened the anicut and built an additional wall on top of it to the effect that more water was led to the powerhouse.

ABC had no government permission to heighten the anicut. In a construction approval letter, Bangalore's Secretariat of the Water Resource Department determined certain conditions under which the 4.5 MW plant was to be built. The letter stipulated that "for no reason should the height of the anicut be increased" and "the basic structure of the anicut should not be changed" [62]. Yet, with the construction of a concrete layer on top of the anicut, which more than doubled its initial height, the company flouted the conditions set by the Water Resource Department.

In the beginning villagers, only being inadequately and reluctantly informed about the plant, were not aware of these conditions set by the government. Especially the occurrence of a severe drought in 2003 convinced initially skeptical villagers to evaluate the changes done at the anicut more favorably. A fortified and

heightened anicut offered the prospect of being able to store water, which seemed useful in times of uncertain water availability. So, by 2003 the anicut had been turned into a solid, small dam changing Tungabhadra's water flow when passing Ullenoor and Bennur on the left bank and Mannur and Sugur on the right bank. When earlier “the water used to flow easily down the river” [63] it now hit an approximately 5-m high concrete wall built across the river, which diverted the water towards a newly built powerhouse and its turbines before being led back to the river. But, as Gram Panchayat members from Bennur recalled, “it did not happen the way [we] expected it, that the [stored] water would be useful” [63]. And with the rainy season of 2004 approaching initial doubts about the anicut's height resurfaced.

3.3.2. Emerging resistance

People from Bennur and Ullenoor expressed their uneasiness about the power plant first orally, by visiting two different types of government authorities, the local Irrigation Department and the District Authority. Visiting the authorities in person allowed people to make sure that the issue actually reached the officers, made it possible for people to express and explain the issue and its urgency more extensively, and implied that they would receive a first reaction from the officer involved. Yet soon, engagement activities went beyond these individual contacts with government authorities. Early on, an influential person from Ullenoor, ‚Raman supported the complaints and efforts by the left bank farmers to receive information about the hydro project and its design. Farmers from Ullenoor had approached Raman, whose family owns a lot of land along Tungabhadra's left bank, close to Ullenoor. Furthermore, his appointment as Koppal District – Secretary of the KRRS underpinned his strong engagement for farmers' interests. The Karnataka Rajya Raitha Sangha, KRRS, is the most prominent farmers' organization in Karnataka. Founded as a populist rural mobilization of farmers in August 1980, the KRRS has been able to draw on a large support' base [64,65].

In his function as KRRS District Secretary, Raman wrote a letter in which he officially voiced the uneasiness of the left bank farmers about the heightened anicut to local government authorities. In this letter, dated 30.6.2004, Raman warned the District Commissioner (DC) of Koppal District of the possible inundation of adjacent lands due to the heightened anicut. “Therefore”, Raman wrote, “you should personally visit this project and … identify by expert opinion the area which might be submerged and to secure compensation for the farmers through your mediation. If you do not take suitable action …, struggles will be organized under the aegis of KRRS” [66]. Raman's letter bundled individual actions and clearly increased the issue's urgency by threatening to hold organized protests.

As a result of the visits and Raman's letter, both the Irrigation Department and the District Authorities started to attend to the matter by inspecting the site and producing reports on it. By the beginning of August 2004 the threat of submergence due to the plant and the need to act in order to avoid flooding of fields were officially recognized by the Irrigation Department. The company was prompted to abide by the stipulations set out in the approval letter. Yet, despite these instructions, the anicut remained unchanged. In mid-August 2004 after the opening of the Tungabhadra dam, farmlands got flooded around the Sugur site, causing just the situation of submergence that Raman had cautioned against in his letter. The heightened anicut had dammed up the water flow released from the Tungabhadra dam such that it flooded the riverbanks, entering into the paddy fields and destroying the standing crop.

In response to these events, public water authorities started to investigate the incidents at the Sugur power plant. However, it seemed that just as the company did not abide by the orders of the Irrigation Department, none of the involved public authorities pursued the issue rigorously – and the plant kept operating with the anicut unchanged.

3.3.3. Organization of engagement

By writing the warning letter to the district authority of Koppal district, Raman had formalized farmers' reservations against the plant with its heightened anicut under the aegis of the state-wide farmers' organization KRRS. Due to his work at the KRRS he was familiar with advocacy processes of farmers' interests and interacting with authorities. Also, by formalizing the query under the KRRS, Raman could make use of the organization's statewide reputation and its large membership, which both potentially increased the urgency and leverage of the matter. However, these advantages of a well-established organization do not necessarily entail the commitment of local people. Farmers affected by the Sugur plant were skeptical about the involvement of the KRRS in the case. Raman realized that to gain the support of the local farmers he had to distance himself from the KRRS. Especially the international, national, and state-wide agitation history of the KRRS was seen by the people as a burden in their own struggle, since it bestowed their efforts with a political legacy that they did not regard as helpful. Moreover, the issues at Sugur seemed too local and specific to fit into the broader agenda of the KRRS; so organizational detachment from the KRRS seemed sensible to Raman. Raman formed a new organization, the Raitha Hitarakshana Samiti (RHS), especially set up to fight for the farmers' interests in the Sugur case. At the end of August 2004, he founded and registered the RHS and became its elected president. The aim of the RHS was twofold, encompassing past and future events: ensuring financial compensation for the accrued crop loss and avoiding financial loss caused by future submergence of fields.

3.3.4. Stepping up engagement measures

The following year did not bring any changes to the situation at the Sugur plant site. The anicut remained unchanged and there were no compensations paid for the accrued crop loss. So, with the anicut remaining at a height of about 5 m the monsoon floods of 2005 destroyed the standing crop of farmers having land along the river for the second time.

This led Raman to resort to yet another form of engagement in order to endorse the RHS's interests. As President of the RHS he filed a petition at the High Court of Karnataka in October 2005. The petition detailed the events at the Sugur site, and thereby showed how the RHS made sense of the events unfolding at the Sugur site: Raman accused the involved offices of the Irrigation Department, the District Authorities and the company of collusion. “[They] chose not to act to implement the government orders and their own orders and except assurances and meetings, no action was taken” [67]. Raman petitioned the Court to issue a writ, which would order the parties to comply with orders and rules, “preserve the Ancient Dam in its originality”, and “pay compensation to farmers for loss caused to them” [67]. Yet, filing the case at the Court did not induce any action on the part of the company or the government authorities. The anicut remained unchanged.

Frustrated by the perpetual inaction and the prospect of the approaching flood destroying their crop for the third time in a row, RHS farmers and sympathizers from Ullenoor and Bennur went to the anicut equipped with axes, mattocks, and spades. Starting from the left bank side at Bennur village, they began destroying the anicut using their hand-held workshop tools. They broke the top layer of the massive concrete dam for some meters until the arriving police stopped them (see Fig. 4). Yet, this fierce intervention by the farmers did not cause any action beyond enraged letter exchanges and damage protocols, because, though partly dismantled by the farmers, the anicut's height still caused inundation of farmland.



Fig. 4. Farmers destroy parts of the anicut in August 2006. (Picture credits Raman.)

Early in 2007 it came to what Raman described as a "hostage situation" [68]. Due to a routine workplace-rotation a new District Commissioner had taken office in Koppal District. During a scheduled plant site visit, and accompanied by Irrigation Department engineers, he was to inform himself about the situation regarding Sugur's power plant. Yet, in the last moment he decided not to attend the site inspection personally. Anxious to make the new DC aware of the situation at the Sugur site, RHS members and sympathizers forced Irrigation engineers who had come to the scheduled meeting to stay at the site. They were not allowed to leave until they had convinced the new DC to come and inspect the Sugur plant site personally. The hostages were released only when the DC finally arrived at the scene and farmers could personally express the urgency of the matter. Detaining public officers to enforce a collective demand is not uncommon in rural areas where farmers have been reported to resort to this act especially due to water and electricity scarcity [69–71]. In the case of Sugur, the farmers resorted to this action in order to make themselves heard, hoping this would finally elicit action on the part of the public authorities.

3.3.5. A context of corruption

In November 2006 the management of the Sugur small hydro plant had been taken over by the Bangalore-based company Bhavya. The new company seemed to be willing to enter into discussions with farmers about the unresolved issues at the plant. While the plant management change heralded a rapprochement between the company and the RHS, for the Irrigation Department the take-over induced a re-thinking of its approach, in which it started to substantiate its long proclaimed positions with action. Shortly before the captured monsoon waters of 2007 were released at the Tungabhadra dam, the Irrigation Department dismantled the concrete top-layer on a stretch of about 1/3 of the total length of the anicut (about 250 m).

In the Court petition the RHS had accused the Irrigation Department of accepting bribes from the company to remain inactive. Work by Robert Wade has revealed the deep-rooted system of administrative and political corruption in the context of South Indian irrigation [72–74]. This context embeds the statement by the new Managing Director who, too, alluded to corruption when explaining the events unfolding at the Sugur site. When asked about the Sugur case, he carefully stated, "In Sugur what happened: [the previous plant owner] wanted to maximize his generation. … But [the previous plant owner] managed it in a political manner, not in a technical manner" [75]. When challenged to explain how he thought the previous plant manager managed the case in a political manner, the answer was more reluctant: "You get the politicians and all the right people. So people keep quiet. So, go and talk to the MLA[4] and tell him: Don't worry, Sir… So, some way you find out some methodology or something" [75]. The "methodology", as the Director discretely puts it, comprises the act of bribing.

The case of the Sugur plant is different from the fairly well-documented situation of corruption in the context of canal water distribution, in which influencing the transfer of office posts (by MLAs) and the allotment of construction contracts (by officers) is the driving force of the system [76,77]. In Sugur, the source of the money did not stem from construction and maintenance contracts, but was established by the SHP company, which paid money so that public authorities remained inactive.

The rapprochement between the new company management and the RHS changed established relations in the Sugur case. The new management's approach to deal with the Sugur case "technically rather than politically" and to discuss the issue of compensation with farmers ended the relation the Irrigation Department had hitherto maintained with the previous company management and strengthened the role of the RHS. Officially, the Irrigation Department's position, which it had stipulated in diverse communications, did not change; practically, however, the Irrigation Department decided to act by following up on the stipulations it had endorsed for more than two years. Although it undertook action and dismantled the heightened anicut for a substantive part, the monsoon water released in 2007 still submerged river-bank land and caused subsequent crop loss.

3.3.6. Stalling of new arrangements

Meanwhile the discussions between farmers and the new company management became more concrete. In October 2007, to settle the unresolved issues of the newly acquired power plant, Bhavya's management invited farmers' representatives of affected villages on both sides of the river – Bennur, Ullenoor as well as Mannur and Sugur – to its premises in Bangalore.

For farmers the meeting in Bangalore was a chance to finally settle the long-lasting issue of receiving financial compensation for the accrued crop loss they had suffered for four consecutive years. Eventually, both parties, came to an agreement: To prevent future submergence floodgates were to be installed in the anicut, which was to retain a height of 4.72 m. To compensate for past losses, the company was ready to pay an average amount of 100,000 INR (approx. 1000 Eur.) per submerged acre for a total area of 350 acres. The conflict, which began with the increasing uneasiness that farmers expressed about the heightened anicut in 2004, finally seemed to have come to an acceptable end for the company as well as for the farmers.

In a letter addressed to the Executive Engineer, the RHS communicated the outcomes of the Bangalore meeting to the Irrigation Department shortly upon its return from Bangalore. The Irrigation Department, however, did not endorse the agreement, and less than two weeks later the Executive Engineer issued a notice ordering to recuperate Tungabhadra's water flow. "The additional wall built on the anicut" was to be dismantled [78]. The notice set a clear time limit for action. If the company did not dismantle the anicut "within 10 days", the Irrigation Department would withdraw the permission given to the company to operate the power plant. The notice left "no scope for letter correspondence in this regard" [78].

For the Irrigation Department the Bangalore agreement made it clear that power relations in the Sugur case had changed, not in the authority's favor. The source of income, which the power plant under the former management provided for the Irrigation

[4] MLA is the abbreviation for Member of Legislative Assembly. MLAs are directly elected representatives to this assembly at the state level, which is also called Vidhan Sabha or lower house. Karnataka's Legislative Assembly has 224 members, who are elected from constituencies across the state.

Department, had vanished. With the new management, a rapprochement between farmers and Bhavya took place culminating in the agreement in Bangalore. By issuing a notice to dismantle, the Irrigation Department reinforced its control and re-aligned its practice with the stipulations it had issued since the beginning of the conflict.

3.3.7. Final dismantling of the anicut

During the conflict the anicut had been the object of dismantling efforts several times: In the beginning frustrated RHS farmers dismantled it partly; later, in 2007 the Irrigation Department dismantled another stretch. In the beginning of January 2008, though with a delay of about a month, the new company management demolished the remaining part of the heightened anicut. While the lowered anicut diminished the risk of future submergence, the RHS's second aim, to receive compensation for their loss, was still unresolved. Bhavya interpreted the issuance of the notice as implicitly rendering the arrangements with the farmers in Bangalore as void. This forced the RHS to put the issue of compensation back on the agenda. After negotiations failed in 2008, Bhavya abandoned individual negotiations involving public authorities and farmers by communicating to both that "consideration of the compensation to the farmers will be taken up only after the court verdict" [79]. Making its actions dependent on the Court's ruling adjourned the issue of compensation payments indefinitely. With an overburdened court it is not likely that the farmers' demands will be taken up quickly [80–82]. In 2013, seven years after issuing the petition, the case was still unattended. With Bhavya's decision to wait until the court's verdict engagement activities around the Sugur site have abated. The height to which the anicut was eventually brought down does not threaten the standing crop in times of high water tables. And while farmers still await compensation payments for past losses, Tungabhadra's highly demanded waters flow down her riverbed.

4. Conclusions

This article set out to inquire about the social acceptability of SHP projects in India by looking at how the plants are actually doing in practice. By taking the local perspective and context as a starting point this study contributes to a research focus that has so far been neglected. Importantly, this approach facilitates the development of theoretical insights based on analytical generalization [85], in which the detailed empirical analysis highlights broader theoretical issues that play a role in the development of SHP that have so far not yet been described.

First, both case studies strikingly point to the fact that small hydroelectric plants are contested. This observation is important because it runs counter to ubiquitous notions of SHP as a technology that is essentially uncontested, due to it being green, clean and small. Research with case findings from Europe and elsewhere has highlighted that small-scale renewable energy technologies raise issues of social acceptance, which have to be taken into consideration [86–92]. This analysis corroborates these findings for the case of SHP.

The engagement of local people played a crucial role in the contestation of the SHP plants. In Sugur, individual engagement activities were soon concentrated and organized under the aegis of a newly founded farmers' organization, the RHS. To gain attention and underline the urgency of their demands, the RHS engaged in a range of activities, stepping up its engagement measures. After a myriad of correspondence and meetings with local authorities and the company, and the filing of a petition at Karnataka's High Court, their activities culminated in the part-dismantling of the anicut and the taking of hostages. In Kenchanaguddam, local engagement shaped design changes of the plant. Vedant's complaints in the name of those served by the Deshnur canal eventually led to the installation of sluice gates. Engagement activities of Kenchanaguddam's farmers' lobby, however, rendered the design change ineffective. The case studies show not only the existence of local engagement activities, but also the important role the perseverance of individuals played in the contestation of the plants. Both Vedant and Raman had resources at their disposal, such as contacts, skills, money and time, that enabled them to organize and lead the engagement activities effecting significant and unexpected impact.

The Indian government is encouraging the development of small hydroelectric plants through diverse policy measures [3]. Yet, the occurrence of local engagement activities is largely neglected in policy and general debate about SHP projects in India. Barriers to SHP development are exclusively identified in the financial, regulatory and infrastructure-related realms [20,21,1]. The strong prevailing "green–clean–small" feature of SHP projects in combination with the locality of the conflicts seems to prevent other issues of entering and opening up a larger, more nuanced debate. Abbasi and Abbasi have made a similar argument with regard to SHP development and the plants' perceived environmental-friendliness [26]. The prevalent belief in them being green, clean and small and the locality of the impacts have left them out of the critical debate.

Both the intensity and the scope of local engagement activities with small hydroelectric plants underline the importance to acknowledge that this phenomenon should be taken seriously. This demands a broader, more pro-active approach to the development of SHP than what seems to be the current practice. Notably, issues that are contested about the two studied SHP plants are very similar, though on a different scale, to some of the well-acknowledged societal problems emerging with large-scale hydro projects. If applied consciously and critically – and not based on an understanding of an automatic panacea [93,94] – participation in its many forms, methodologies and approaches has been suggested to at least alleviate many of the societal contestations arising from development projects [95–97]. The case studies suggest that consideration and extension of more inclusive, transparent and pro-active approaches to the development of SHP seems valuable. Research in STS has stressed that technologies need to be embedded in society if they are to be effective. When aiming to meet the growing energy demands in a sustainable way, a narrow focus on the promotion of renewable - based – technological fixes is not enough.

This relates to the second finding that emerges from the analysis of the cases. In the development of SHP the existence of water infrastructures with its intricate dynamics of water flows has to be taken much more seriously, both in research and practice. When constructing the plants in Sugur and Kenchanaguddam existing water infrastructure played an important role. Both companies made use of the existence of anicuts by incorporating them into their design. The incorporation of the anicuts was exclusively designed with the water supply for the power plant in mind. Consequences for the functioning and design features of the anicuts were not considered. In doing so the dynamics of the local water flow changed significantly, triggering all kinds of effects. This means that accounting for existing water infrastructure and a broad consideration of water users should be an integral part of a pro-active approach to SHP development.

An important feature of the plants under study is their storage-based design. The analysis suggests that storage-based projects tend to be accompanied by issues of storage-weir modifications that go against official design approvals. Technically, heightening the storage weir seems to be a relatively simple way of increasing electricity production, and thus the profits for the SHP developers. Sugur's and Kenchanaguddam's SHP projects were implemented and are functioning in a context of corruption and bribes, which seems to constitute an enabling factor.

This leads to the fourth finding of the analysis. With the construction of the plants a new source of money was

established and accessing it constituted and triggered a great part of the engagement activities, which took place around the plants in Sugur and Kenchanaguddam. In the Sugur case, corruption was seen to explain why engagement activities were long ignored by government authorities. In Kenchanaguddam references to corruption and bribes explained the infectivity of design changes and the way the distribution of water was handled. Corruption is a known malady in India's administrative and political system [98], including the South Indian irrigation bureaucracy. The corruptive practices of different local actors – which include the business, public, and civic sector – render the regulatory framework void. Endemic norms of behavior emerge and locally frame the working of SHP projects. Corruption cannot be simply “regulated away” as scholars have emphasized [98,99]. Though a pro-active approach might not solve the complex issue of corruption in Indian life, locally it may offer alternative and additional ways in interacting – for example when developing SHP.

In conclusion, the Kenchanaguddam case and the Sugur case illustrate that the implementation of SHP projects does not take place in a void. Rather, complex existing physical and social realities on the ground matter for the development and performance of the plants – and should be taken more seriously by policymakers, researchers and SHP-developers alike.

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Appendix A. List of references to specific documentation regarding the case studies

Reference	Type of document/title	Author	Date
Approval letter, 2002	Letter	Water Resource Department, Bangalore	20.11.2002
Bhavya letter, 2008	Letter	Bhavya	29.5.2008
Bhavya letter, 2007	Letter	Bhavya	21.3.2007
Department, n.d.	Note on Right Bank Vijayanagara Channels	Water Resource Department, Bangalore	n.d.
Inspection CE, 2004	Inspection report	Chief Engineer, ICZ	13.8.2004
Letter CE, 2005	Letter	Chief Engineer, ICZ	10.6.2005
Letter Raman, 2004	Letter	Raman	30.6.2004
Letter RHS, 2007	Letter	RHS	19.11.2007
Minutes, 2008	Minutes of meeting	DC Koppal	18.2.2008
Notice, 2007	Notice (order)	Executive Engineer, ICZ	6.12.2007
Petition, 2005	Petition	Advocate	23.10.2005
RHS draft agreement, 2007	Draft agreement	RHS	April–March 2005
RHS letter-a, 2008	Letter	RHS	8.3.2008
RHS letter-c, 2008	Letter	RHS	8.3.2008
ABC letter, 2006	Letter	ABC company	4.9.2006
TCE, 2003	Detailed Project Report: Kenchanaguddam Mini Hydel Scheme (3 × 2 MW)	TCE Consulting Engineers Limited, Bangalore	2003, Bangalore
TCE, n.d.	Detailed Project Report: ABC Power Industries LTD: Sugur Mini Hydel Scheme (3 × 1.5 MW)	TCE Consulting Engineers Limited, Bangalore	n.d., Bangalore

Appendix B. List of interviewees

Institution/occupation	Date	Location of the interview
Bennur Gram Panchayat	3.8.2010	Bennur
Deshnur Gram Panchayat	6.8.2010	Deshnur
Kenchanaguddam Gram Panchayat	5.8.2010	Kenchanaguddam
Sugur Gram Panchayat	7.8.2010	Sugur
Ullenoor Gram Panchayat	4.8.2010	Ullenoor
Farmers	21.7.2009	Bennur
Farmers	6.8.2010	Deshnur
Farmers	7.8.2010	Sugur
Farmers	23.7.2009	Vinaknagar

President Farmers' Organization RHS	17.3.2009; 20.7.2009; 21.7.2009; 3.8.2010	Gangavati
Representatives of Water User Association, Gangavati Taluq	24.7.2009	Kartagi
Representatives of Water User Association, Sirguppa	22.7.2010	Sirguppa
Assistant Executive Engineer, No. 2 L.L.C. Subdivision, Sirguppa	Several meetings 2009, 2010	Sirguppa
Assistant Engineer, Munirabad Central Zone, Kampli	Several meetings 2009, 2010	Kampli
Chief Engineer, Irrigation Department, Irrigation Central Zone (ICZ)	4.8.2010	Munirabad
Assistant Executive Engineer, ICZ	4.8.2010	Munirabad
Panchayat Development Officer	7.8.2010	Sugur
Member of the Legislative Assembly	17.2.2009	Sirguppa
Bhavya Managing Director International	24.7.2010	Bangalore
Bhavya General Manager – Civil	24.7.2010	Bangalore
Executive Director Navya Power Projects	2.8.210	Kenchanaguddam
Director Asian Regional Initiative (International Energy Initiative – NGO)	3.3.2009	Bangalore
Director of the Centre for Education and Documentation	15.1.2009	Bangalore
Joint Director Livelihood, Center for World Solidarity	31.7.2009	Hyderabad
Energy Group member, Prayas (NGO)	27.7.2010	Hyderabad
Director South Asia Network on Dams Rivers and People (NGO)	28.7.2010	Delhi
Research Associate, Centre for Budget and Policy Studies	20.10.2010	Bangalore
Free-lance researcher on anicuts and water management	Several meetings 2008, 2009, 2010	Bangalore
Senior Advisor – Energy, Swiss Agency for Development and Cooperation	19.8.2010	Delhi
Research Associate, Swiss Agency for Development and Cooperation	19.8.2010	Delhi
Assistant Professor, Centre for Public Policy, Indian Institute of Management, Bangalore	23.1.2009	Bangalore
Chief Technical Advisor, Centre for Electronics, Design and Technology, Indian Institute of Science, Bangalore	14.6.2009	Bangalore
Professor for Rural Management at Indian Institute of Management, Bhubaneswar	13.8.2010	Bhubaneswar
Senior Fellow at Centre for Interdisciplinary Studies in Environment and Development	Several meetings 2008, 2009, 2010	Bangalore

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